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Effects of Gibberellin on Redox Enzyme Activity and Leaf Chlorophyll Pigments in Maize Leaf Cells

L.K. Yunusova[1], Yulchiev E.Yu[2], Mirzaev Sh[3]

[1,3]*Teacher of the Department of Genetics and Biotechnology of Andijan State University, Andijan city, Uzbekistan*
[2]*Associate Professor of the Department of Genetics and Biotechnology of Andijan State University, Andijan city, Uzbekistan*

Abstract: In the article, the effect of gibberellin on the activity of oxidation-reduction enzymes and leaf chlorophyll pigments in the cells of the leaf of the corn plant was studied on the basis of field and laboratory experiments. It was found that when gibberellin suspension is sprayed on plants, the amount of chlorophyll "a" increases, especially during the periods of sultan release. The amount of chlorophyll "b" increased during the ripening phase. The ratio of chlorophyll "a" and "b" had the highest value in the period of growth, and the lowest value in the period of ripening. Carotenoids increased during sultana release and decreased during ripening. Photochemical reduction in leaf chloroplasts under the influence of gibberellin suspension increased by 20-30% compared to the control in all periods of vegetation. The studied Uzbekistan 601 ESV variety was distinguished by its reactivity.

Keywords: Maize, Leaf Cells, Redox Enzymes, Enzyme Activity, Chlorophyll, Pigment, Gibberellin.

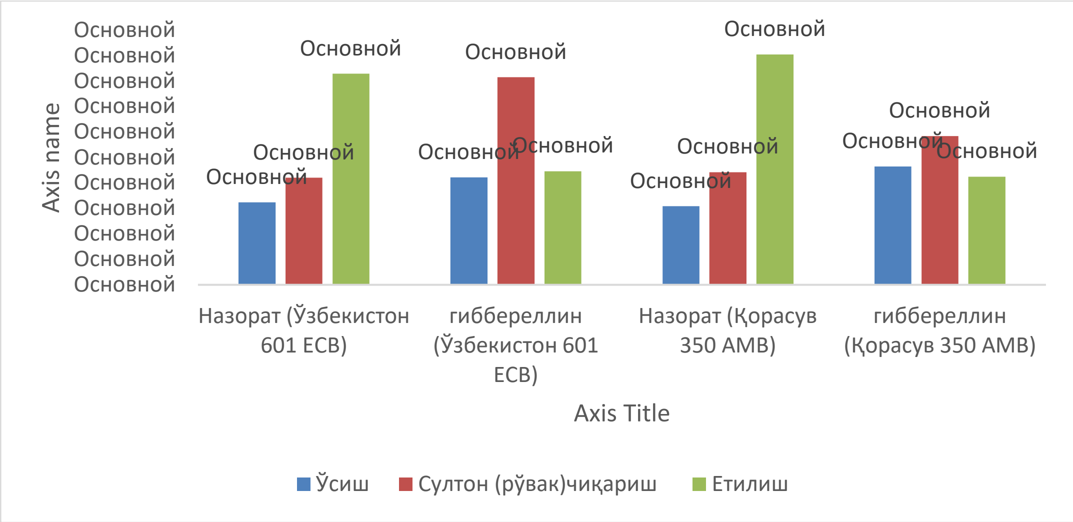
1. Introduction

Tall sorghum plants belong to the Poaceae family, Sorghum genus, and there are several species. Among them, the most common and economically important is corn (Zea mays L.), followed by white and black sorghum (Sorghum vulgare Pers.) and technical sorghum (S. technicum Roshev.). These plants are widely planted (on large areas) in Uzbekistan and occupy an important place in the economy. These plants have a large number of varieties and hybrids, distinguished by their quick ripening, yield and quality, and are planted for different periods and purposes.
The homeland of corn is recognized as Mexico. The United States takes the highest place in the cultivation of this plant, 280 million per year. t. delivers grain, followed by China (131 million tons) and Brazil (34 million tons). Maize is the 3rd largest grain producer, after wheat and rice.
Corn is an annual, monoecious plant. Female flowers appear as inflorescences at the tip of the stem, while male flowers appear at the tip of the plant in the form of sultans. The root part of the plants is strongly developed, the layered tap root, but the central taproot can go down to 3 m. [1,2]. Its height can reach from 60 cm to 2-3 meters.
Corn is a wind-pollinated plant. Male and female flowers do not open at the same time. This ensures their cross-pollination. In order for the plant to pollinate well, the air should be warm and humid enough, with a light wind blowing: dry air and high temperature will cause poor pollination of corn cobs and incomplete cobs.
Corn is a light-loving short-day plant. It begins to bloom when the light day is 8-9 hours, but with a 12-14-hour day, the growth period is extended, and the yield decreases. Therefore, in the conditions of Central Asia, it is effective to plant corn in early periods, or to sow it in the morning, because the flowering period corresponds to the time when the light is shorter, the air temperature is lower, and the air humidity is sufficient [2].
This plant is grown for grain and silage. Grain yield, depending on the variety and conditions, can be on average 32.5 t/ha, maximum 70-80 t/ha, and blue stem 170-230 t/ha, maximum 400 t/ha [2,3].
Another opportunity arose due to the sharp increase in the area of grain (winter wheat) planting in our republic. Even if it is, it is connected with the early sowing of wheat and relatively early (June) vacating of the cultivated fields, which means planting and growing different alternative, second crops on these lands [1,2, 4,5]. Of course, corn is the most cultivated among them (in 2015, this plant was 37.5% in Andijan region and 52.8% in Fergana region). In addition, white and black sorghum and broom are planted in large areas. Maize is planted in certain areas starting from spring (early periods). In accordance with the intended purpose, along with early varieties

(for the purpose of growing stalks for food and livestock), fruitful late varieties and hybrids are planted. Most of them are grown as fodder for livestock and poultry, the grain yield is 90-100 t/ha (biological yield 140-160 t/ha), and the stem yield is 800-1500 t/ha without sorghum, and with sorghum (for silage) - It can yield 1620 tons/ha (Krasnodar 1/49 and VIR-42 medium hybrid varieties).
In the conditions of the Fergana Valley, the late type of corn is planted more often, and it is the main source for livestock in farmers' farms. Different varieties and hybrids of corn are planted here, and even quick-ripening grains and plant stems that ripen in a short period of time (80-90 days) are grown.
In the 30s of the 20th century, N.G. Holodniy and V.V. Vent created the instruction on phytohormones. They proposed the hormonal theory of plant growth.
Then it was discovered that plants contain phytohormones such as auxins, gibberellins, cytokinins, abscisins, and ethylene. Phytohormones were identified by Boysen-Jensen in 1938 and E. in 1963. Synnot suggests calling it "growth substances". In the following years, they began to be called "plant hormones", "phytohormones" [6,7].
These compounds are formed in the young leaves of plants, growing parts of stems and roots, and then are transferred to the active areas of growth processes. They exert their effects in a very small amount, that is, they participate in several reactions in the plant body and control them.
In recent years, the use of artificial forms of physiologically active substances in agriculture is increasing year by year. They are mainly used in several directions: to accelerate growth and development, to stop growth and accelerate ripening, and to control weeds.
The growth, development and productivity of agricultural crops depends on the normal passage of energy processes, which is the main controlling factor of the processes of plant metabolism. Specialized energy structures in plants, including mitochondria, produce energy-rich macroergic compounds by biological oxidation of respiratory substrates. Chloroplasts convert the light energy of the sun into the energy of the chemical garden through photophosphorylation and synthesis of carbohydrates in the dark. These two interrelated processes - respiration and photosynthesis determine the physiological and biochemical conditions of the plant, supply energetic and plastic substrates. These factors determine growth, development and productivity.
Based on the above considerations, in this study, we aimed to study the activity of certain enzymes in the leaves of two types of corn under the influence of 10% suspension of gibberellin and to study the effect on the amount of leaf plate pigments.
Gibberellin phytohormones are mainly used in agriculture in the form of 0.0001-0.1% solution. Since they are poorly soluble in water, they are first dissolved in ethyl alcohol and then mixed with water. Then it is sprayed on the plants.
Activity of succinate-, malate- and glutamate dehydrogenase enzymes was determined according to N.A. Ells (1959), peroxidase according to V.F. Gavrilenko et al. (1975).
Isolation and quantification of chloroplasts was carried out according to V.F. Gavrilenko et al. (1975). The volume of the extraction medium is 3 ml, ADF – 1 µM, NADF – 3 µM ferrodoxin 50 µg/ml chloroplast 50 µg/ml phosphate buffer (pH 7.8). Ferrodoxin was isolated from spinach leaves (according to Mukhin et al. 1973).
The amount of plastid pigments in isolated chloroplasts was determined in a chlorophyll SF-16 spectrophotometer according to D. I. Arnon (1949), and the amount of chlorophyll "a" and chlorophyll "v" and carotenoids was calculated based on the formula of D. Wetstein (Wettstein 1957). The photochemical activity of chloroplasts was evaluated based on the rate of NADF reduction (Mukhin et al., 1973), and the intensity of noncyclic photophosphorylation was determined based on the consumption of inorganic phosphate in the reaction medium (Gavrilenko et al., 1975).
The amount of plastid pigments and photosynthetic reactions were studied in cotton development phases: 3rd, 4th leaf formation, tillering, flowering and ripening stages. Statistical reports were performed according to GF Lakin (1990), A. Asatiani (1965).
Changes in the activity of oxidation-reduction enzymes were studied in order to study the mechanism of action on the energy systems of corn leaf cells when a 10-7% suspension of gibberellins was sprayed on plants. Therefore, the activity of peroxidase enzymes succinate dehydrogenase (SDG 2 KF 1.3.99.1), malate dehydrogenase (MDG-KF 1.1.1.37.), glutamate dehydrogenase (GDG-KF 1.4.1.2.) and the activity of peroxidase enzyme of leaf cells in the main periods of corn vegetation were studied. The obtained data are presented in Table 1.
The obtained results show that the level of activation of enzymes SDG and MDG in the mitochondria of both varieties of corn leaf increased by 3-5% under the influence of gibberellin. The activity of GDG increased by 2 times in both varieties under the influence of the first stimulant, and by 5-7% in the second.

The obtained data show that the activity of leaf peroxidase increased by 24% during the growth period of the Uzbekistan 601 ESV variety compared to the control. The sultana period is the most metabolically active phase of the plant, and enzyme activity in leaves during this phase is high in the control and in both variants. At the ripening stage, under the influence of gibberellin, the enzyme activity was reduced by half in the leaf compared to the control

Table 1 Effect of gibberellin on peroxidase enzyme activity in some organelles of maize



Karasuv 350 AMV cultivar showed higher sensitivity of peroxidase enzyme to the stimulus applied, and the activity of this enzyme in the leaf increased by 42% compared to the control during the growth period. In the sultana phase, the enzyme increased by 35% in the leaves. As in Uzbekistan 601 ESV, Karasuv 350 AMV leaf peroxidase activity decreased by half under the influence of gibberellin.

Different phenols, amines, diamines, pyridine coenzymes, cytochrome C can serve as substrates for peroxidase. Therefore, there may be a certain degree of connection between the increase in the activity of mitochondrial dehydrogenases and peroxidase enzymes under the influence of gibberellins. Stimulation of peroxidase activity in the period of sultana release of corn development in all variants of the experiment under the influence of gibberellin is clearly visible. This period of development is distinguished by the growth of energetic processes and the strengthening of grain accumulation. The activity of peroxidase in the leaves has the highest value during the growth period, in the experimental and control plants.

In subsequent experiments, the effects of gibberellin dissolved in ethyl alcohol and then mixed with water at 10-7% suspension on the plants are shown in Table 2. Under the influence of gibberellin suspensions, the amount of pigments in the plastid, their ratio, had different values in different phases of development depending on the corn variety. When plants were sprayed with a 10-7% suspension of gibberellin, the amount of chlorophyll "a" in Uzbekistan 601 ESV variety during the initial stage of development was slightly lower compared to the control, and increased by 6.45% during the growth period, by 8.8% when the sultana was released, and by 12% during the ripening phase. . In absolute values, chlorophyll "a" in control and experimental plants increased by 1.5 times compared to the previous stage of growth and sultan release in chloroplasts. In the ripening phase, chlorophyll "a" increased by 8% compared to the first stage.

The data obtained on chlorophyll "v" showed that it increased by 13% compared to the control during the initial leaf release, by 6.2% during the growth period, by 5% during the sultan release, and by 5.8 percent during the maturation phase. Unlike the results obtained for chlorophyll "a", the amount of chlorophyll "b" in the chloroplasts of Karasuv 350 AMV variety increased according to the stages of development. Such a situation is probably related to the compensatory-protective reaction of chlorophyll "b" in the plant leaf. On the one hand, during the maturation phase, the amount of chlorophyll "a" decreased, the amount of chlorophyll "b" increased, and on the other hand, the compensatory-antenna activity of chlorophyll "b" can ensure the high level of photochemical activity.

In contrast to the biosynthesis of chlorophyll "a" and "b", under the effect of gibberellin suspension, the amount of carotenoids increased by 14% compared to the control during the initial leaf release, by 13% during the growth period, by 7.5% during the sultan release phase, and by 5% during the ripening period. The reduction of carotenoid biosynthesis in the last development phase may have slowed down the growth processes to a certain extent and directed the biosynthetic processes towards the formation of the crop.

In Uzbekistan 601 ESV corn, when 10-7% suspension of gibberellin was sprayed on plants, the amount of pigments in the plastid changed little. The amount of chlorophyll "a" and "b" at the first leaf emergence was slightly reduced compared to the control. Chlorophyll "a" increased by 4.6%, chlorophyll "b" by 4%, during the growth period, chlorophyll "a" increased by 3.8%, chlorophyll "b" increased by 3%. Carotenoids increased by 12.3% in the initial phase, by 10.8% during growth, and by 5.7% during maturity by 6.9%. In order to compare the effects of these preparations on the synthesis of plastid pigments, experiments conducted with Karasuv 350 AMV variety are presented in Table 2. The amount of plastid pigments in Karasuv 350 AMV cultivar at the first leaf emergence decreased slightly compared to the control under the influence of gibberellin. During the growth phase, chlorophyll "a" increased by 2.5%, chlorophyll "b" by 6.8%, and carotenoids by 8.6%. During the period of Sultan release, the amount of chlorophyll "a" increased by 10.4%, the amount of chlorophyll "b" increased by 5.4%, and carotenoids increased by 8.3%. During ripening, chlorophyll "a" increased by 8.6%, chlorophyll "b" by 8.9%, while carotenoids remained at the control level.

As can be seen from the table, the amount of chlorophyll "a" was higher during the growth and sultan release periods, while it decreased during the ripening phase, and the amount of chlorophyll "b" increased, the total amount of chlorophyll "a" and "b" was greater during the growth period, during the sultan release period. approached the control level.

During this period, carotenoids remained at the control level. The obtained results show that the periods of growth and sultan release are metabolically and biosynthetically active and highly responsive to exogenous influences.

Table-2 Effects of 10-7% suspension of gibberellin on the amount of plastid pigments in the main stages of corn development when plants are sprayed

The name of developmental periods and stimuli	Experience option	Leaf chlorophyll content (mg/g)					
		Xl. «a»	Xl. «b»	Xl. «a» + Xl «b»	Каротиноид	Xl.«a»/ Xl.«b»	Xl.«a» + Xl «b» Carotenoid
Karasuv 350 AMB							
Initial leaf release	H	0,93±0,09	0,176±0,02	1,1	0,29±0,03	5,5	3,7
Gibberelllin	T	0,92±0,07	0,14±0,02	1,0	0,24±0,04	6,4	4,3
Growth	H	1,34±0,11	0,25±0,03	1,6	0,34±0,06	5,7	4,3
Gibberelllin	T	1,38±0,07	0,35±0,03	1,6	0,37±0,05	5,4	4,7
Release sultan (ruvak).	H	1,32±0,09	0,46±0,04	1,8	0,39±0,04	3,0	4,7
Gibberelllin	T	1,53±0,11	0,48±0,04	2,0	0,42±0,04	3,1	4,7
Maturation	H	0,91±0,08	0,67±0,08	1,5	0,20±0,02	1,3	7,0
Gibberellin	T	0,99±0,06	0,73±0,05	1,7	0,20±0,02	1,3	8,4
Uzbekistan 601 ESV							
Initial leaf release	H	1,05±0,12	0,21±0,02	1,2	0,30±0,03	4,9	4,1
Gibberellin	T	0,97±0,08	0,24±0,02	1,1	0,35±0,03	5,0	3,3
Growth	H	1,42±0,11	0,27±0,03	1,6	0,36±0,03	5,2	4,6
Gibberellin	T	1,51±0,09	0,29±0,03	1,8	0,41±0,04	5,2	4,3
Release sultan (ruvak).	H	1,43±0,12	0,51±0,04	1,9	0,56±0,04	2,7	3,4
Gibberellin	T	1,56±0,09	0,54±0,05	2,1	0,60±0,08	2,8	3,4
Maturation	H	0,98±0,11	0,72±0,06	1,6	0,24±0,03	1,3	6,6
Gibberellin	T	1,11±0,08	0,76±0,06	1,8	0,26±0,03	1,4	7,2

Note: Xl- chlorophyll

In conclusion, it can be said that when the gibberellin suspension is sprayed on the plants, the amount of chlorophyll "a" increases, especially during the periods of sultan release. The amount of chlorophyll "b" increased during the ripening phase. The ratio of chlorophyll "a" and "b" had the highest value in the period of growth, and the lowest value in the period of ripening. Carotenoids increased during sultana release and decreased during ripening [8].

Photochemical reduction of leaf chloroplasts under the influence of gibberellin suspension increased by 20-30% compared to the control in all periods of vegetation. The studied Uzbekistan 601 ESV variety was distinguished by its reactivity.

When the gibberellin suspension was sprayed on the plants, the harvest was 5-7 days earlier, and the yield increased by 2-3 ts compared to the control.

2. References

1. Полевой В.В. Физиология растений. –М.: “Высшая школа”, 1989. 464 с.
2. Мауер Ф.М. Некоторые морфологические и физиологические особенности семян хлопчатника и их сельскохозяйственное значение. Акционерное общество. - М.: Прописдат, - 1927. – С. 29-31
3. Романов Г.А. Рецепторы фитогормонов // Физиол. раст. 2002. Т. 49, № 1. 615-625 с.
4. Кнорре Д.Г., Мызина С.Д. Биологическая химия. М.: “Высшая школа”. -2000. 479 с.
5. Юлчиев Э., Юнусова Л., Мўйдинов И. Эртапишар маккажўхори (Zea mays L.) навли ўсимлик барги хужайраларидаги оксидланиш-қайтарилиш ферментлари фаоллигига гиббереллиннинг таъсири// Инновацион ғоялар, ишланмалар ва уларни ишлаб чиқариш ҳамда таълимда қўллашнинг замонавий муаммолари. Халқаро илмий-амалий анжуман. Андижон, 2019 йил 15-апрел
6. Семихатова О.А., Чиркова Т.В. Физиология дыхания растений. Изд-во СПбГУ, 2001, 220 с.
7. Полевой В.В., Саламатова Т.С. Физиология роста и развития растений. Л. Изд-во ЛГУ, 1991. 229 с.
8. Юнусова Л., Э.Ю.Юлчиев, С.Содикова Физиологик фаол моддаларнинг ўсимликнинг ўсиш даврида пероксидаза ферментига таъсири// Андижон давлат университетининг 90 йиллигига бағишланган Илм – фан ва таълим мамлакат тараққиётининг муҳим омили мавзусидаги республика илмий-амалий анжуман материаллари. Андижон – 2021. 261-264 б.